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Glycine Level in GOT, GPT Enzyme Activity, and Its Relationship to Heart Disease

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Abstract. This study aims to study the relationship between glycine levels and the activity of glutamate-oxaloacetate transaminase (GOT) and glutamate-pyruvate transaminase (GPT) in different tissues (blood, heart, liver) and explore the impact of this relationship on heart and liver diseases. Data were collected from thirty patients with varying levels of glycine in the blood, and the activity of GOT and GPT enzymes was measured in blood, heart and liver samples, with the effect of glycine on the activity of these enzymes analyzed. The results showed that glycine levels were positively correlated with GOT and GPT enzyme activities in blood, heart, and liver. For example, in blood, the results showed that GOT enzyme activity was 15.29 U/100ml protein at 0.3% glycine level, and increased to 19.0 U/100ml protein at 8.1% glycine level. In heart, GOT enzyme activity was 18.21 U/100ml protein at 0.3% glycine level, and increased to 18.3 U/100ml protein at 4.0% glycine level. In liver, the enzyme activity was initially 14.72 U/100ml protein at 0.3% glycine level, and then increased to 19.0 U/100ml protein at higher glycine levels. The results also showed a significant increase in the total tissue activity with increasing glycine levels. In blood, the total activity increased from 14.1 U at 0% glycine to 31.4 U at 2.0% glycine. In the heart, the total activity increased from 27.0 U to 33.8 U at the same glycine levels, reflecting the effect of glycine in enhancing the enzyme activity in cardiac tissue. These results are an important step towards understanding the effect of glycine in improving enzyme activity and promoting metabolic balance, especially in the context of heart and liver diseases. The study also highlights the therapeutic potential of glycine as a nutritional compound in mitigating the effects of oxidative stress and improving the health of damaged tissues. Based on these results, glycine may play a pivotal role in developing new therapeutic strategies to enhance the health of heart and liver tissues. Finally, this study contributes to adding new knowledge about the role of glycine in improving the levels of enzymes that contribute to the balance of metabolic reactions and protecting tissues from damage resulting from oxidative stress, which opens new horizons for medical and therapeutic research in this field.

Highlights:

1. Glycine enhances GOT & GPT enzyme activity in blood, heart, and liver.
2. Increased glycine levels improve metabolic balance and tissue health.
3. Potential therapeutic role of glycine in heart and liver diseases.

Keywords: Glycine, Enzyme Activity, Metabolic Balance, Heart Health, Liver Function

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Introduction

The enzymes glutamate-oxaloacetate transaminase (GOT) and glutamate-pyruvate transaminase (GPT) play a crucial role in many biochemical processes, especially in amino acid metabolism and maintaining metabolic homeostasis in the body. These enzymes are important biomarkers for assessing tissue health, especially cardiac and hepatic tissues, as their activity is associated with various cardiac and hepatic diseases (Stoica et al., 2021). In addition, the activity of these enzymes contributes to reducing glutamate toxicity by converting it to less harmful compounds, which contributes to neuroprotection (Campos et al., 2011).

Glutamate, an important neurotransmitter, plays a dual role in the body. Although it is essential for many physiological functions, its excessive levels, especially in the brain, can lead to severe neuronal injury, such as that resulting from hypoxia or stroke. Studies have shown that elevated tissue glutamate is associated with activation of glutamate receptors that leads to a series of toxic reactions, including neuronal cell death (Lepage et al., 1997). Therefore, controlling glutamate levels, especially in the brain and blood, is crucial for preventing neuronal injury (Hays et al., 2007).

Although GOT and GPT enzymes are important in reducing glutamate toxicity, the mechanisms that control fetal blood glutamate levels, especially during periods of stress such as hypoxia during birth, remain unclear. Preliminary studies indicate differences in glutamate levels between maternal and fetal blood, raising questions about the role of these enzymes in regulating these levels and protecting the fetal brain from damage resulting from oxidative stress (Cetin et al., 2005).

This study aims to explore the relationship between glutamate levels and GOT and GPT enzyme activity in maternal and fetal blood. It also seeks to clarify how this relationship affects neuroprotection in the fetal brain. Through this research, we hope to provide a deeper understanding of the mechanisms controlling glutamate levels and provide new clues for developing therapeutic strategies to protect neural tissues from injuries associated with oxidative stress and hypoxia (Boyko et al., 2012).

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Methods

2.1 Study population

Thirty adult patients diagnosed with varying levels of glycine in the blood participated in this study. The participants' ages ranged from 25 to 60 years. The patients were selected regardless of gender, medical history, or previous health status, but they were ensured to meet specific criteria, such as the absence of other acute diseases that might affect the results.

2.2 Experimental design

The participants were followed up at the university hospital during the study period, where blood and tissue samples (heart and liver) were collected under strict laboratory conditions.

Sample collection steps:

- Venous blood samples were collected from each patient in an amount of 5 ml using dedicated syringes.
- Small samples (about 1 g) were collected from heart and liver tissues during necessary surgical procedures or upon informed consent from the participants.

After sample collection, each sample was divided into two parts:

1. Part (0.2 ml of blood) to determine the concentration of glycine and the activity of the enzymes GOT and GPT in whole blood.
2. The remaining part was used to analyze the enzyme activity in serum and tissues (heart and liver).

The following data were collected from medical records and through comprehensive questionnaires:

- Age and gender.
- General health status and medical history.
- Medications used by the patients.
- Family history of any chronic diseases.
- Lifestyle and influencing factors (such as diet and level of physical activity).

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2.3 Measurement of GOT and GPT enzyme concentrations in serum and tissues

The levels of GOT and GPT enzymes were analyzed using fluorescence technology in the hospital's biochemistry laboratory. The analysis was based on the conversion of glutamate to alanine and aspartate in the presence of GOT and GPT enzymes and an Olympus AU 2700 device was used to perform the measurements.

Analysis steps:

1. Serum was separated by centrifugation at 3000 rpm for 10 minutes.
2. Tissues (heart and liver) were analyzed after grinding and preparing them in a buffer solution for enzyme activity analysis.

2.4 Measurement of glycine concentration in blood and tissues

Glycine concentration was measured using high-performance liquid chromatography (HPLC). The steps included:

1. Sample preparation by adding 200 µl of blood or tissue extract to a protein inhibitor solution.
2. Centrifugation of the sample at 10,000g × for 15 minutes at 4 °C.
3. A solution dedicated to glycine analysis using HPLC was used, and the concentration was determined by comparing the results to a standard curve.

2.5 Statistical Analysis

Data were analyzed using SPSS 26.0:

- Analysis of variance (ANOVA) was used to compare glycine levels and GOT and GPT enzyme activity in different samples.
- Pearson's correlation coefficient was used to study the relationship between glycine concentration and enzyme activity in blood and tissues.
- Statistical differences were considered significant at $p<0.05$ and highly significant at $p<0.01$.

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2.6 Ethics standards

Approval was obtained from the university ethics committee before starting the study. All participants signed an informed consent form explaining the purpose of the study and the significance of the expected results

Result and Discussion

In this study, the effect of glycine levels on GOT enzyme activity in different tissues (blood, heart, and liver) was studied through internal and external measurements of enzyme activity. The effect of glycine on cellular activities and total activities in these tissues was measured, and the effects were analyzed according to different glycine levels (0, 0.3, 1.0, 1.5, 2.0).

2.3 Data analysis

The extracted data was divided into four main tables related to glycine levels and its effect on enzyme activity in different tissues. We will analyze these tables in detail as follows:

According to the results in Table (1), it appears that there is a difference in the activity of the GOT enzyme and an increase in glycine levels. In the blood, there is a slight change in the activity of the GOT enzyme with an increase in glycine levels from 0 to 8.1. At the level of 0.3 in the blood, the initial activity showed 15.29 and then began to decrease when glycine levels increased. As for the heart, the results showed a clear increase in the activity of GOT with an increase in glycine levels, as the enzyme activity was 18.21 at the level of 0.3 and then decreased to 18.3 at 4.0 glycine.

According to the results, it appears that glycine works to reduce or decrease the activity of GOT and is neutral in cardiac tissues.

While in the liver, the results are similar to those in the blood, as the enzyme activity was initially low at 14.72 and showed an increase in the enzyme activity after increasing glycine levels, which shows the opposite role of glycine in increasing the GOT enzyme in the liver.

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Table 1: Effect of glycine on GOT enzyme activity in tissues

Tissues	Glycine level (%)	Impact rate	Activity U/100ml Protein
Blood	0	0.3	15.29
	8.1	19.0	0.77
H**eart**	0	0.3	18.21
	4.0	18.3	0.32
Liver	0	0.3	14.72
	0	0.3	15.29

In Table (2) the results are similar to those in Table (1). In the blood, it was shown that there is a noticeable increase in external cellular activity with an increase in glycine levels. In the heart, there is also an increase in cellular activity with an increase in glycine, which indicates that glycine stimulates cellular activity in both the blood and the heart. As for the liver, it appears that the effect on external cellular activity is less with an increase in the glycine level.

Table 2: Effect of glycine on extracellular activity

Tissues	Glycine level	extracellular activity
Blood	0	12.3
	1.0	14.2
	1.5	15.3
	2.0	16.8
Heart	0	12.8
	1.0	14.3
	1.5	16.8
	2.0	18.2
Liver	0	10.3
	1.0	12.2
	1.5	13.1

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	2.0	14.2

In Table (3), it is shown that the intrinsic cellular activity increases with increasing glycine levels, indicating a stimulatory effect of glycine on cellular activity in the blood. In the heart, the greatest effect in increasing intrinsic cellular activity appears with the highest glycine level (19.1), proving that glycine may have a greater role in activating cellular activities within cardiac tissue compared to other tissues. In the liver, with increasing glycine from 0 to 2.0, a greater effect appears on intrinsic cellular activity in the liver, indicating that glycine may play a role in activating cellular processes within liver tissue.

Table 3: Effect of glycine on intracellular activity

Tissues	**Glycine level**	**extracellular activity**
Blood	0	14.1
	1.0	15.3
	1.5	15.62
	2.0	16.1
Heart	0	14.7
	1.0	16.3
	1.5	16.8
	2.0	19.1
Liver	0	11.3
	1.0	13.32
	1.5	14.18
	2.0	15.6

In Table (4) it is shown that in blood, the total activity increases with the increase of glycine, as it can be observed that the total activity at glycine level 2.0 (31.4) is significantly higher than at level 0 (14.1). This may indicate a stimulating effect of glycine on blood tissues. In the heart, the total activity was higher compared to blood, and increasing glycine leads to a significant increase in the total activity, indicating a strong effect of glycine in enhancing enzymatic activity in cardiac tissues. In the liver, the total effect was less than blood and heart, but with increasing glycine, an improvement in the total activity was observed, reflecting the effect of glycine on improving or modifying cellular activities in hepatic tissues.

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Table 4: Effect of glycine on total activity

Tissues	Glycine level	extracellular activity
Blood	0	14.1
	1.0	27.6
	1.5	29.8
	2.0	31.4
Heart	0	27
	1.0	30.6
	1.5	33.2
	2.0	33.8
Liver	0	21.6
	1.0	25.6
	1.5	27.3
	2.0	29.8

Conclusion

In this study, we investigated the relationship between glycine levels and the enzyme activities of glutamate-oxaloacetate transaminase (GOT) and glutamate-pyruvate transaminase (GPT) in different tissues, such as blood, heart, and liver, with a focus on the impact of this relationship on cardiac and hepatic diseases. The results showed that glycine levels were associated with increased GOT activity in the studied tissues, as they showed a significant increase in enzyme activity with higher glycine levels, while the effect of glycine on GPT activity was less pronounced. These results are consistent with previous studies such as Campos et al. (2011) which indicated that high GOT activity was associated with improved functional outcomes in stroke cases, as well as Boyko et al. (2012) which confirmed the role of GOT in reducing glutamate toxicity by converting it to less dangerous compounds. Other studies such as Maher (2019) have shown that the effect of GPT is less significant compared to GOT in reducing glutamate toxicity. These results suggest that glycine plays a pivotal role in improving enzyme activity, especially GOT, which promotes neuroprotection and metabolic functions in

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various tissues. Based on these findings, glycine could be a promising nutritional agent for improving the health of cardiac and hepatic tissues, especially under conditions associated with oxidative stress. However, further studies are needed to more precisely understand the molecular mechanisms linking glycine to the activity of these enzymes, as well as to evaluate the long-term clinical effect of using glycine as a dietary supplement. The study also suggests novel therapeutic potential for glycine in alleviating oxidative stress and promoting the health of tissues affected by chronic diseases, opening up new avenues for research in this field

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